AIR FORCE

QUALIFICATION TRAINING PACKAGE (AFQTP)

for

UTILITIES SYSTEMS

(3E4X1)

MODULE 12

UTILITIES FUNDAMENTALS

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MODULE 12

UTILITIES FUNDAMENTALS

Career Field Education and Training Plan (CFETP) references from 1 Apr 97 version.

OPR: HQ AFCESA/CEOT

Certified by: HQ AFCESA/CEO
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AIR FORCE QUALIFICATION TRAINING PACKAGES
for
UTILITIES SYSTEMS
(3E4X1)

INTRODUCTION

Before starting this AFQTP, refer to and read the "Trainee/Trainer Guide" located on the AFCESA Web site http://www.afcesa.af.mil/

AFQTPs are mandatory and must be completed to fulfill task knowledge requirements on core and diamond tasks for upgrade training. ***It is important for the trainer and trainee to understand*** that an AFQTP ***does not*** replace hands-on training, nor will completion of an AFQTP meet the requirement for core task certification. AFQTPs will be used in conjunction with applicable technical references and hands-on training.

AFQTPs and Certification and Testing (CerTest) must be used as minimum upgrade requirements for Diamond tasks.

MANDATORY minimum upgrade requirements:

Core task:
AFQTP completion
Hands-on certification

Diamond task:
AFQTP completion
CerTest completion (80% minimum to pass)

Note: *Trainees will receive hands-on certification training for Diamond Tasks when equipment becomes available either at home station or at a TDY location.*

Put this package to use. Subject matter experts under the direction and guidance of HQ AFCESA/CEOT revised this AFQTP. If you have any recommendations for improving this document, please contact the Career Field Manager at the address below.

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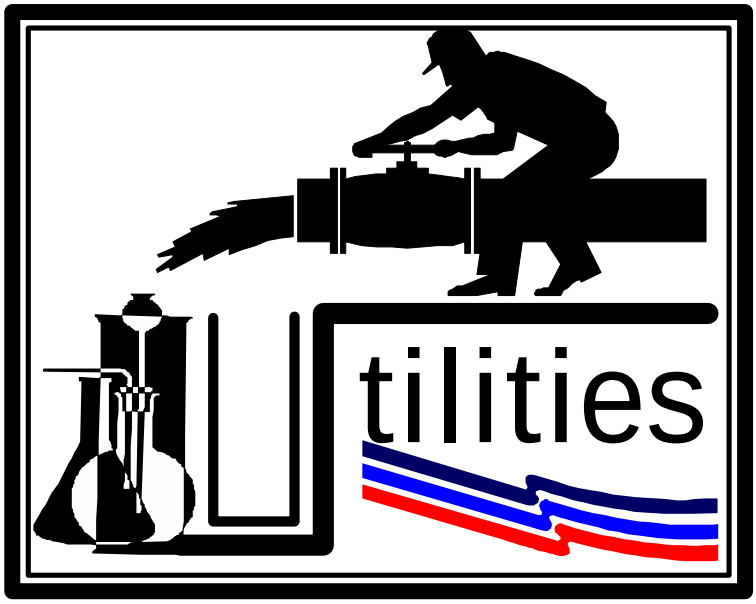
Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.



UTILITIES FUNDAMENTALS

MODULE 12 AFQTP UNIT 6

CUT/REAM/THREAD/SWEAT PIPE (12.6.)

CUT/REAM/THREAD/SWEAT PIPE

Task Training Guide

STS Reference Number/Title:	12.6., Cut/Ream/Thread/Sweat Pipe
Training References:	• CERTEST VIDEO #830 Pipe and *Pipefitting*, • CDC 3E451A Vol. 2 (Trade Fundamentals) • Study Guide/Workbook J3ABR3E431 003/004/005-III • Uniformed plumbing Code
Prerequisites:	• Possess as a minimum a 3E431 AFSC.
Equipment/Tools Required:	• General Plumbing Hand tools, Tubing cutter, Pipe cutter, Torch Kit , Fitting brush, Emory cloth, Flux, Solder, Fire Extinguisher, Manual pipe threader, Hand Reamer, Power threader
Learning Objective:	• Trainee will properly cut/ream/thread/sweat pipe.
Samples of Behavior:	• Trainee will understand the steps to cut/ream/thread/sweat pipe.
Notes:	

CUT/REAM/SWEAT PIPE

Background: Refer To CERTEST Video #830: Pipe and *Pipe-fitting*
Basic Procedures for Soldering/Sweating Pipe

Soldering/Sweating. Of the many ways to make copper joints, we commonly use sweat-soldered joints. Sweat-soldering (called sweating) is a method of joining two metals by allowing molten solder to run between the tubing and fittings. The law of capillary action governs the force responsible for the bonding in solder joints.

There are four major steps to sweating pipe: clean it, coat it, heat it and solder it. The tubing must be cut to length and reamed before you are ready to solder the joint. The amount of solder required for a connection depends upon the diameter of the tube to be sweated.

To produce the necessary heat, use an air-acetylene torch or a propane torch. A high-temperature concentrated flame that quickly brings the fitting to the melting point of solder is required for "sweating" fitting on copper tubing. Ninety-five/five solder (95% tin and 5% antimony or any solder with a lead content of 0.20% or less) melts at 425 degrees F. To prevent the joint from overheating, apply the heat evenly back and forth across the connection. Overheating the joint could cause the flux to burn out, oxidation, and the flux to spread unevenly.

SAFETY:
BEFORE SOLDERING IN QUESTIONABLE AREA, YOU SHOULD HAVE THE FIRE DEPARTMENT INSPECT THE AREA AND ISSUE AN AF FORM 592, WELDING, CUTTING AND BRAZING PERMIT. MAKE SURE YOU FOLLOW ANY INSTRUCTIONS THE INSPECTOR PLACES IN BLOCK 12 OF THE PERMIT TO REDUCE THE HAZARD OF FIRE. MAKE SURE AN APPROPRIATE FIRE EXTINGUISHER IS IN REACH

To perform the task, follow these steps for soldering:

Step 1: Cut pipe/tubing.
Measure and cut the pipe/tubing with a tubing cutter, or a hacksaw keeping the cut as straight and square as possible.

Step 2: Ream pipe/tubing
Ream the interior of your pipe/tubing with the reamer provided on the tubing cutter or a hand reamer.

Step 3: Clean pipe/tubing.

Clean the pipe/tubing and the fitting using a fitting brush, emery cloth, or steel wool. Cleaning the surfaces will ensure a good bond between the base metal and the solder. (Figure 1)

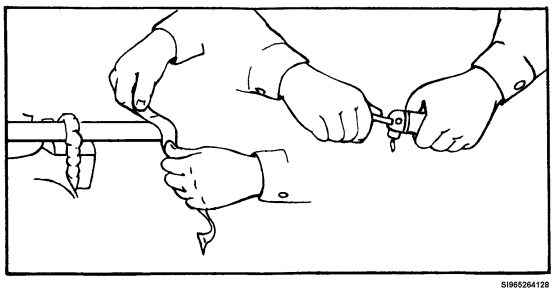


Figure 1, Clean pipe/tubing and fitting

Step 4: Coat pipe/tubing and fitting.

Flux must be applied to the inside of the fitting and onto the outer surface of the pipe/tubing to prevent oxidation and to promote fusion in the soldering process. (Figure 2)

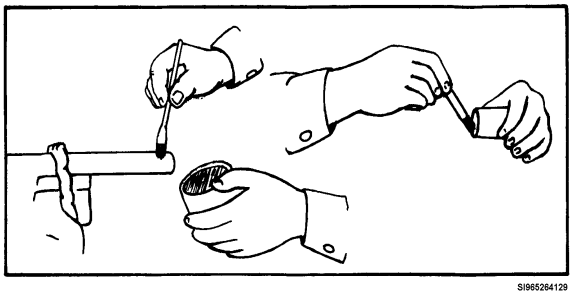


Figure 2, Application of Flux

Step 5: Join fittings.

After fittings have been fluxed, slide pipe/tubing into fittings

Step 6: Heat fitting.

Apply heat evenly around the fitting. Do this by moving the flame back and forth. This procedure also keeps you from over heating the tube fitting or burning out the flux. When soldering small diameter pipe/tubing you can apply the heat to one area of the fitting.(Figure 3)

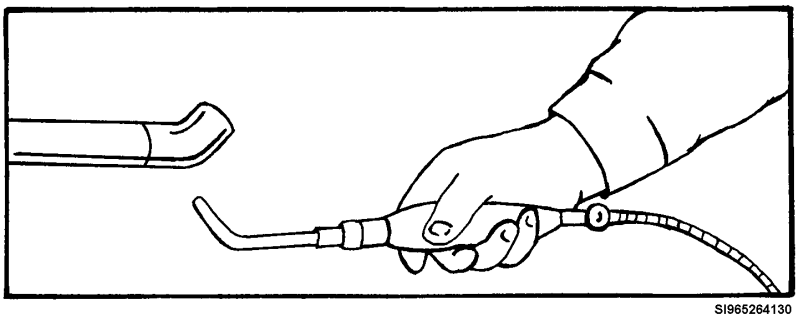


Figure 3, Heating the Fitting

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

NOTE:
When heating the fitting for soldering long sleeve shirts should be worn to prevent burns as well as leather gloves.

SAFETY:
1. **IF A TORCH IS NOT BEING USED, TURN OFF THE GAS AND SET ASIDE THE TORCH**
2. **USE A HEAT SHIELD IN ENCLOSED AREAS WHERE A FIRE COULD EASILY BE STARTED**

Step 7: Solder joint.
Touch the solder to the fitting while applying heat. As soon as the connection is hot enough to melt the solder, remove the flame and apply the solder to the edge of the fitting. The solder will then be drawn into the fitting by capillary action (Figure 4)

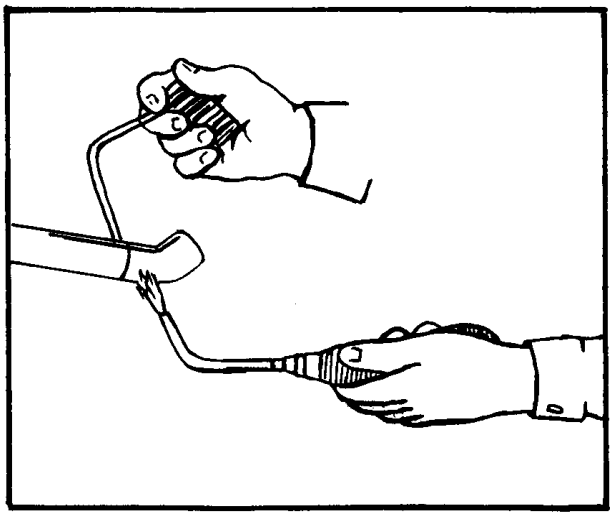


Figure 4, Application of Solder

Step 8: Re-Heat it.
Reheat the fitting slightly to help the solder penetrate the metal.

Step 9: Remove heat.

Step 10: Continue to feed solder.
When a bead of solder appears at the edge of the fitting the joint has all the solder it will take.

HINT:
Applying flux to the fitting prior to cooling the joint will remove some of the excess solder.

Step 11: Allow the joint to cool.
Use a wet rag to help cool the joint.

Step 12: Remove excess solder.
Remove excess solder with a small brush or fine emery cloth.

Step 13: Slowly open water valve & check for leaks.
If leaks are found, close valve, drain the system, and remove line by re-heating with torch.. **Use slip joint pliers to remove the fitting and repeat steps 3 thru 12.**

Step 14: Clean area & place tools in proper areas.

CUT/REAM/THREAD PIPE

Background: Refer To CERTEST Video #830: Pipe and *Pipe-fitting* Basic Procedures for Cutting, Reaming, and Threading Pipe

Threading Pipe, There are different methods and equipment used to thread steel pipe. If you are on an isolated job site or working with smaller diameter pipe you may have to thread pipe manually using a manual pipe threader. In other cases where you are working on a large project or the pipe is larger in size you may have to use a power driven threader.

There are three major steps to threading pipe: cutting the pipe, reaming the pipe to restore the inside diameter, and threading pipe.

SAFETY:
BEFORE USING A POWER THREADER INSPECT THE EQUIPMENT AND POWER SOURCE TO ENSURE IT IS PROPERLY GROUNDED AND ALL PARTS ARE IN GOOD WORKING CONDITION. DO NOT WEAR JEWELRY, GLOVES OR LOOSE CLOTHING. KEEP YOUR FINGERS AND LIMBS AWAY FROM MOVING PARTS. USE SAFETY GLASSES OR FACE SHIELDS TO PROTECT YOU FROM PIPE SHAVINGS.

To perform the task, follow these steps for threading:

Step 1: Cut pipe.
Measure and cut the pipe with a pipe cutter, a power threader, or a hacksaw keeping the cut as straight and square as possible.

Step 2: Ream pipe
Ream the pipe using a hand reamer, power threader, or a file. (Reaming the pipe restores the inside diameter of the pipe by removing any burrs, which are created during the cutting of the pipe.)

Step 3: Inspecting equipment
Inspect the die segments to ensure that they are sharp and free from excessive wear.

NOTE:
If using a power threader ensure that the cutting oil in the reservoir is at the proper level. Application of cutting oil will cool dies as they are threading the pipe, this will prevent damaging the threads.

Step 4: Threading pipe
When threading pipe first insert pipe into the vice. Place the manual pipe threader on the pipe and applying force to get the dies started with the heel of your hand. Make three or four short turns in a clockwise direction to start the dies. Once you have started the dies apply cutting oil every two or strokes of the handle. Continue this until approximately two newly cut threads project beyond the die segments.

NOTE:
When using a power threader swing the die head into position, ensuring the dies are closed and are set to the proper size for the pipe you are threading. Next turn on the machine to ensure that the cutting oil is flowing. Use the handle on the moving carriage to push the dies onto the pipe with firm pressure. Once the dies begin to thread release the carriage handle. Allow the threader to self-feed. Once two newly cut threads extend beyond the die segments, lift the die release lever and back off the carriage.

Step 5: Clean the new threads
Use a wire brush.

Step 6: Remove the pipe

Step 7: Clean equipment
Clean the die segments using a wire brush to remove any shavings and wipe up any excess oil.

NOTE:
When using the power threader also remove the shavings from the catch tray.

Step 8: Inspect threads
Visually inspect the threads and check for proper threads by hand tightening the section of pipe into a fitting. If it threads into the fitting with ease your threads are good.

Step 9: Clean Area & place tools in proper areas

Review Questions
for
Cut/Ream/Thread/Sweat Pipe

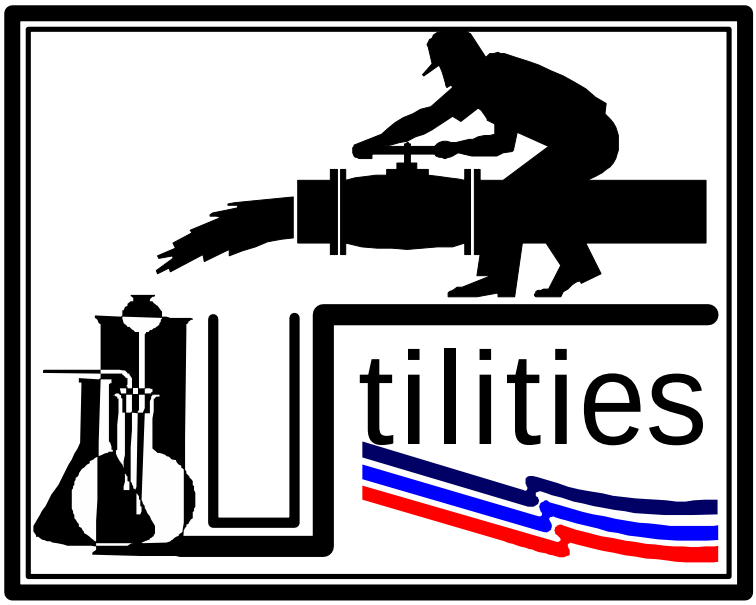
Question	Answer
1. There are how many major steps to sweating pipe?	a. One b. Two c. Three d. Four
2. What governs the bonding process in sweating?	a. Gravity b. Pressure c. Capillary Action d. Bonding Action
3. 95/5% Solder melts at ____degrees F.	a. 300 b. 325 c. 400 d. 425
4. The amount of solder required for a connection depends upon the diameter of the tube to be sweated.	a. True b. False
5. What causes the flux to burn out, oxidation, and the flux spreading unevenly?	a. Overheating the joint b. Too much solder c. Too little solder d. Too much flux
6. Before soldering in a questionable are, you should have the Fire Department inspect the area and issue an AF Form 591, WELDING, CUTTING AND BRAZING PERMIT.	a. True b. False
7. When a bead of solder appears at the edge of the fitting, what does this indicate?	a. The joint has all the solder it will take b. Too much solder c. An overheated connection d. Non of the above
8. What is used to remove excess solder?	a. A small brush or emery cloth b. Steel wool or sand paper c. A rasp file d. Non of the above
9. What is used to restore the inside diameter of the pipe by removing any burrs?	a. Hand reamer b. Power threader c. File d. All of the above

Question	Answer
10. What equipment should be inspected to ensure that they are sharp and free from excessive wear prior to threading pipe?	a. Cutter b. Oiler c. Die segments d. Segment holder
11. What is used to keep the dies cool when threading pipe?	a. 10W-30 b. 40 weight c. Linseed oil d. Cutting oil
12. How often should you apply cutting oil to the dies when using the manual pipe threader?	a. 1 to 2 strokes b. 2 to 3 strokes c. 4 to 5 strokes d. 6 strokes
13. When using a power threader you should lift the die release lever when ___ newly cut threads extend beyond the die segments.	a. 4 b. 3 c. 2 d. 1
14. What should be used to clean the die segments?	a. Rag b. Fitting brush c. Emory cloth d. Wire brush

CUT/REAM/THREAD/SWEAT PIPE

Performance Checklist		
Step	**Yes**	**No**
1. Did trainee identify all the equipment needed for cutting, reaming, and soldering/sweating pipe? • Tubing cutter • Hacksaw • Hand reamer • Fitting brush • Emory cloth • Steel Wool • Flux • Propane/Acetylene torch • Solder		
2. Did the trainee take proper safety precautions? • Obtained an AF Form 592 • Fire extinguisher was in reach • Long sleeve shirt worn • Gloves worn		
3. Viewing the prescribed video, did trainee understand how to properly cut, ream and thread pipe?		
4. Did the trainee properly thread pipe? • Cut • Ream • Thread pipe		
5. Did the trainee properly solder/sweat pipe • Cut • Ream • Clean • Coat • Heat • Apply solder • Cool		
6. Did the trainee understand how to properly sweat pipe?		

FEEDBACK: Trainer should provide both positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer.



UTILITIES FUNDAMENTALS

MODULE 12 **AFQTP UNIT 8**

DISINFECTION USING CHLORINE (12.8.)

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

DISINFECTION USING CHLORINE

Task Training Guide

STS Reference Number/Title:	• 12.8., Disinfection Using Chlorine
Training References:	• AWWA Standards 1994 Edition • CDC 3E451
Prerequisites:	• Possess as a minimum a 3E431 AFSC.
Learning Objective:	• The trainee understand the purpose of disinfection. • The trainee will know the steps required to perform disinfection of water mains and tanks.
Samples of Behavior:	• Trainee will know required steps to perform disinfection of water mains and tanks. • Trainee must perform disinfection of a repaired water main using the using one of the methods listed in this QTP.
Notes:	
• To successfully complete this element, the steps must be followed exactly--no exceptions • Any safety violation is an automatic failure.	

DISINFECTION USING CHLORINE

Background: The purpose of disinfection is to kill organisms (pathogens) that are harmful to humans. When chemical methods are employed, the environment and or the organisms' structures are altered causing the organisms to die. This process is known as disinfection and the chemical is referred to as a disinfectant. The most widely used disinfectant in water treatment is chlorine (Cl_2). The reason why chlorine is so commonly used is that it leaves a residual. This residual is known as free available chlorine. The free available chlorine is the chlorine left over after all of the pathogens (Disease causing bacteria has) been destroyed. Several critical factors influence disinfection:

- Contact time - The longer the contact time, the better the disinfection.
- Temperature - The higher the temperature, the higher the feed rate.
- Dosage - The higher the dosage, the more rapid the disinfection.
- Chemical strength - The concentration as well as the form of Cl_2 also affect the disinfection rate. A lower feed rate can be used if the concentration of $Cl_2$is higher

pH - A high pH will reduce the effectiveness of chlorine.

All internal components of a distribution system as well as the water distributed must be disinfected. The four main chlorine disinfectants we deal with are: pure chlorine (100% Cl_2 gas), calcium hypochlorite (65% to 70% Cl_2), chlorinated lime (35% Cl_2), and sodium hypochlorite (bleach 5% to 15% chlorine).

SAFETY:
BE SURE TO WEAR PROPER PROTECTIVE EQUIPMENT WHEN WORKING WITH CHEMICALS. ENSURE ADEQUATE VENTILATION IS AVAILABLE WHEN USING CHLORINE.

NEW MAINS. ***To perform this task, follow these steps:***

Step 1: Prevention.

In order to minimize chlorine demand, prevention must first be exercised. Keep foreign material such as rodents, dirt, construction material, and contaminated water out of mains being installed or repaired. Keep all openings plugged or capped when the trench is left unattended.

NOTE:
Plugging of the pipe may not be feasible when there is an excess of ground water.

Step 2: Pre-Flushing.

Use a water velocity of at least 2.5 ft per sec (recommend velocity: 5 ft per sec) to flush each line for at least 30 min. See Figure 1 for the gallons per minute (GPM) required to flush mains. A flow meter or pitot gauge is used to indicate flow velocities. Table 1 shows the rates of flow required to provide a flow velocity of 2.5 fps in commonly used sizes of pipe.

Pipe Size	Velocity of 2.5 ft per sec
4 inch	100 gallons per minute
6 inch	220 gallons per minute
8 inch	390 gallons per minute
10 inch	610 gallons per minute
12 inch	880 gallons per minute
14 inch	1200 gallons per minute

Table 1, Flow Rate Table

To calculate rate of flow (gpm) required for a velocity of 2.5 feet per second (fps) use the following procedure:

- **Convert cross-sectional area of pipe to square feet**.

  sq. ft = (.785)(Diameter, in)^2 ÷ 144 sq. in/sq. ft

  Example: (.785)(12)^2 ÷ 144 sq. in /sq. ft = .785 sq. ft

- **Next determine flow rate in cubic feet per second (CFS).**

  Flow rate, CFS = (Area, sq. ft) (Velocity, ft per sec)

  Example: .785 x 2.5 ft per sec = 1.9625 CFS

- **Next convert from CFS to GPM**.

  GPM = (CFS) (7.48 gal per cubic ft) (60 sec)

  Example = 1.9625 x 7.48 x 60 = 880.77 round 881 GPM

Step 3: Disinfection.

Let's examine three disinfection techniques for water mains continuous feed, slug, and tablet.

Continuous feed: In this method a plug or blank flange is installed on both ends of the main to be disinfected. Then a chlorine form is selected and water from the distribution system is fed at a constant rate into the main at a solution strength of at least 50 mg/l. The hypochlorite solution may be injected into the main with a hypochlorinator. The chlorine residual should be checked at intervals to guarantee that the proper level is maintained. The chlorine feed should continue until the entire main is filled. During this process air should be allowed to escape through an air bleeder valve. The water should stay in the main for a minimum period of 24 hours, during this time all valves and hydrants along the main should be operated to insure their proper disinfection. The goal

To calculate the amount of calcium hypochlorite or sodium hypochlorite, first determine what the initial dosage will be. Next determine the size of pipe, then determine the length and volume of the pipe. Finally, determine the type of disinfectant to be used. Remember that calcium hypochlorite has 65% - 70% chlorine and sodium hypochlorite has a 5% - 15%.(See Table 3 below)

For Sodium Hypochlorite:

- Calculate pipe volume.

  Volume = (.785)(Diameter)^2(Length)(7.48 gal) ÷ 144 sq. in /sq. ft

  Example: .785 x 8^2 x 100 x 7.48 ÷ 144 = 261 gallons of water

- **Next find the pounds of chlorine**

chlorine, lb. = (volume, Million Gallons)(Dose, mg/l)(8.34 lb./Gal)

Example: .000261 Million Gallons x 500 mg/l x 8.34 lb./Gal = 1.09 lb. of chlorine.

- **Then calculate gallons of sodium hypochlorite needed**.

  Gallons of solution = (Chlorine, lb.)(100%) ÷ (8.34 lb./Gal)(Hypochlorite, %)

  Example: 1.09 lb. x 1 ÷ 8.34 x 5% = 2.6 gal of 5 % sodium hypochlorite solution.

For Calcium Hypochlorite:`

- **Calculate pipe volume**.

  Volume = (.785)(Diameter)^2(Length)(7.48 gal) ÷ 144 sq. in /sq. ft

  Example: .785 x 8^2 x 100 x 7.48 ÷ 144 = 261 gallons of water

- **Next find the pounds of chlorine**

  Chlorine, lb. = (volume, Million Gallons)(Dose, mg/l)(8.34 lb./Gal)

  Example: .000261 Million Gallons x 500 mg/l x 8.34 lb./Gal = 1.09 lb. of chlorine.

- **Then calculate gallons of calcium hypochlorite needed**.

  Gallons of solution = (Chlorine, lb.)(100%) ÷ Hypochlorite, %

  Example: 1.09 lb. x 1 ÷ 65% = 1.7 lb. of calcium hypochlorite

SAFETY:
DO NOT USE CALCIUM HYPOCHLORITE IN PIPES THAT HAVE SOLVENT WELDED OR SCREWED STEEL JOINTS. THE REACTION BETWEEN THE JOINT COMPOUNDS AND CALCIUM HYPOCHLORITE COULD CAUSE FIRE OR EXPLOSION

NOTE:
If using chlorine gas during the continuous feed method you must have a pump system to recirculate the water through the section to be disinfected, and provide an injection point for the gas. The water should remain in the main for 24 hrs. with a chlorine residual of not less than 25 mg/l. See Figure 1.

Slug. The slug method involves placing calcium hypochlorite in the main during construction. The main is then filled to eliminate any air pockets. The main is then flushed to remove any particles. A slug (Water dosed with a chlorine concentration of 100mg/l) is then slowly flowed through the main. The slow rate of flow insures that all interior surfaces of the main will be exposed to the highly chlorinated water for a minimum of 3 hours. During this process the free available chlorine residual should be measured in the slug as it travels through the main. If at any time it drops below 50 mg/l, the flow shall be stopped and the chlorination equipment shall be repositioned to feed at the head of the slug. Then as flow is resumed the chlorine shall be fed to restore the free available chlorine in the slug to not less than 100 mg/l. Refer to Table 2.

NOTE:
As the slug flows past fittings, valves, and hydrants they should be operated to disinfect the appurtenances and pipe branches.

Table 2, Dosage Chart

Initial Calcium Hypochlorite at Each Interval of 500 ft	
Pipe Size	**Ounces of Calcium Hypochlorite**
4	.5
6	1.0
8	2.0
12	4.8
16 and larger	8.0

Table 2, Dosage Chart

NOTE:
During slug chlorination if feasible you may increase the dose to 300 mg/l and the contact time may be reduced to as little as 15 minutes.

- **Tablet.** This method is considered the least satisfactory. It is generally used for mains with a small diameter. Preliminary flushing is not performed therefore a weak disinfection residual is the direct result. During construction 5 gram calcium hypochlorite tablets are placed in each section of pipe. One tablet will also be placed in each hydrant, hydrant branch, and other appurtenances located along the main. A food grade adhesive shall be used to attach the tablets. **Some examples of food grade adhesives are Permatex Form-A-Gasket and Permatex RTV Silicone Adhesive Sealant.** The only side of the tablet that should have the adhesive on it should be the side attached to the pipe. Attach all tablets to the interior of the

main on the top side of the pipe. When installation of the tablets is completed fill the main. The main should be filled at a rate, which should not have a velocity of more than 1 foot per second. This water shall remain in the pipe for at least 24 hours. If the water temperature is less than 41* F, the detention time should be for at least 48 hours. See Table 3 for the amount of tablets needed to obtain a 50 mg/l dose for common pipe sizes and lengths of pipe.

Number Of 5 Gram Tablets Need For 50 mg/l dose					
Pipe Size	**Length Of Pipe**				
Inches	13 ft or less	18 ft	20 ft	30 ft	40 ft
4	1	1	1	1	1
6	1	1	1	2	2
8	1	2	2	3	4
10	2	3	3	4	5
12	3	4	4	6	7
16	4	6	7	10	13

Table 3 Calcium Hypochlorite tablet dosage chart

NOTE:
All pipes, fitting, valves, high spots, and pockets not disinfected by fill line must be pre-cleaned and disinfected. Crushed calcium hypochlorite tablets may be placed in joints and hydrant branches to aid in disinfection process. **When disposing of water with a high chlorine residual (more than 1 mg/l) be sure to notify the wastewater plant operator in advance.**

Step 4: Post-Flushing.
After disinfection flush the line until the chlorine residual shows that the concentration leaving the main is not higher than normal distribution system residual or less than 1 mg/l.

Step 5: Testing.
Coordinate with Bio-Environmental Engineering early enough in the disinfection process so they will also be able to test the main after it has been disinfected.

NOTE:
If repairs are made with the line under pressure, no disinfection is required.

MAIN REPAIRS. ***To perform this task, follow these steps:***

Step 1: Drain.
Remove all water from trench using a pail or pump.

Step 2: Sanitize.
Flush and disinfect all portions of pipe, fittings, and materials used in repairs with a 5% hypochlorite solution.

Step 3: Flush.
Operate valves/hydrants to flush the distribution system.

Step 4: Disinfect.
Select a method of disinfection, preferably slug (100mg/l dosage and three hours of contact time).

Step 5: Post-Flushing.
After disinfection flush the line until the chlorine residual shows that the concentration leaving the main is not higher than normal distribution system residual or less than 1 mg/l.

Step 6: Test.
Coordinate with Bio-Environmental engineering early enough, so they also will be able to test the line after it has been disinfected.

TANKS. Disinfection will be required for newly installed water storage facilities, tanks returned to service after being isolated, or whenever there is a possibility that the water has become contaminated.

To perform tank disinfection, follow these steps:

Step 1: Clean the water storage facilities.
Remove all materials not needed for tank operation. Next, scour the interior using high pressure water, scrubbing, sweeping, or similar methods. Finally, remove excess water and accumulated dirt.

Step 2: Disinfect the tank.
Add chlorine to water that is used to fill the tank during disinfection. Maintain a 50 mg/l residual for a contact time of a least 6 hr. (recommend 24 hr.). Use the following to determine how much hypochlorite is needed to complete disinfection.

First find the volume of water for rectangular tanks use the following formula:

Volume = (Length, ft)(Width, ft)(Depth, ft)(7.48 $_{\text{gal/cu ft}}$)

Example: 20 ft x 30 x 10 x 7.48 = 44,880 gal

- Use the following formulas to find the pounds of sodium hypochlorite and the amount of calcium hypochlorite needed.

For Sodium Hypochlorite:

- **Determine volume of a circular tank in gallons.**

  Volume = (.785)(Diameter)^2(Height)(7.48 gal/cu ft)

  Example: .785 x (40 ft)^2 x 10 ft x 7.48 gal/cu ft = 93948.8 gal or 93949 gal

- **Determine pounds of chlorine needed.**

  Chlorine, lb. = (Volume Million Gallons)(Dose, mg/l)(8.34 lb./Gal)

  Example: .093949 x 100 mg/l x 8.34 lb./Gal = 78 Lb. Chlorine

- **Then calculate gallons of sodium hypochlorite needed.**

  Gallons of solution = (Chlorine, lb.)(100%) ÷ (8.34 lb./Gal)(Hypochlorite, %)

  Example: 78 lb. x 1 ÷ 8.34 x 5% = 187 gal of 5 % sodium hypo chlorite solution

For Calcium Hypochlorite:

- **Determine volume in the tank in gallons.**

  Volume = (.785)(Diameter)^2(Height)(7.48 gal/cu ft)

  Example: .785 x (40 ft)^2 x 10 ft x 7.48 gal/cu ft = 93948.8 gal or 93949 gal

- **Determine pounds of chlorine needed.**

  Chlorine, lb. = (volume, Million Gallons)(Dose, mg/l)(8.34 lb./Gal)

  Example: .093949 x 100 mg/l x 8.34 lb./Gal = 78 lb. chlorine

- **Then calculate gallons of calcium hypochlorite needed.**

  Gallons of solution = (Chlorine, lb.)(100%) ÷ Hypochlorite, %

  Example: 78 lb. x 1 ÷ 65% = 120 lb. of calcium hypochlorite

Step 3: Reduce the chlorine residual after required detention time.

To accomplish this, drain and refill the tank, add more holding time, or blend with potable water containing a low chlorine level.

Step 4: Test.

Coordinate with Bio-environmental engineering early enough in so they will also be able to test the tank after it has been disinfected.

Review Questions
for
Disinfection Using Chlorine

Question	Answer
1. What is the purpose of disinfection?	a. Kill organisms that are harmful b. To increase pH c. To remove dirt d. To remove bad taste in water
2. Which disinfectant has a chlorine content of 65% to 70%?	a. Sodium hypochlorite b. Chlorinated lime c. Laundry bleach d. Calcium hypochlorite
3. What is the first step in disinfecting new mains?	a. Flushing the line b. Prevention c. Disinfection d. Testing
4. What is the minimum velocity when flushing mains?	a. 2 ft per sec b. 2.5 ft per sec c. 4 ft per sec d. 4.5 ft per sec
5. Which method is considered the least satisfactory?	a. Slug b. Continuous c. Tablet d. Super chlorination
6. What is the minimum contact time and minimum chlorine residual for the slug method?	a. 3hrs. 400 mg/l b. 3 hrs. 50 mg/l c. 3 hrs. 100 mg/l d. 3 hrs. 25 mg/l

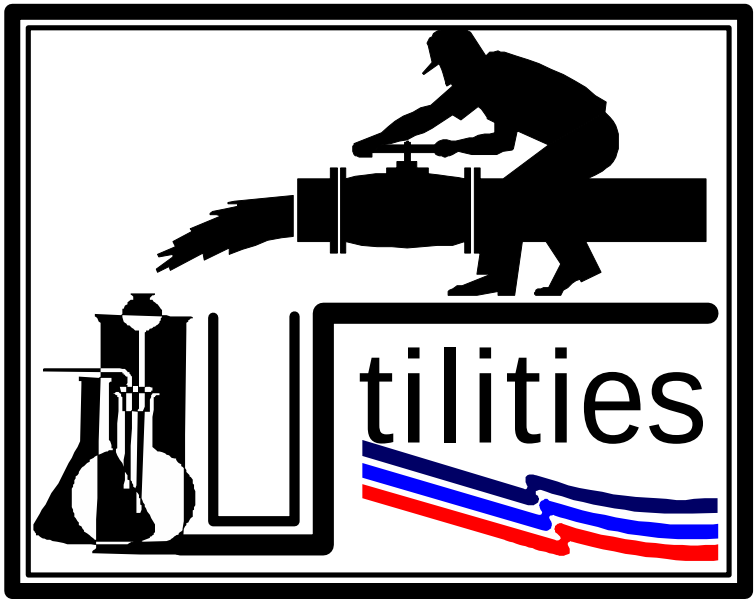
Review Questions
for
Disinfection Using Chlorine

Question	Answer
7. How many tablets of calcium hypochlorite will it take to have 50 mg/l dose for a 4 inch diameter pipe 30 ft long?	a. 1 b. 2 c. 3 d. 4
8. Who do you notify when disposing of water that has a chlorine residual of more than 1 mg/l chlorine residual?	a. Base hospital b. The shop supervisor c. Water plant operator d. Wastewater plant operator
9. Who do you coordinate with to test the water after disinfection?	a. Wastewater plant operator b. Water plant operator c. The shop supervisor d. Bio-environmental engineering
10. Disinfect all portions of pipe, fittings, and materials used in repairs, with?	a. hypochlorite solution b. 5% hypochlorite solution c. Water d. Nothing
11. What is the minimum contact time and chlorine residual when disinfecting storage tanks?	a. 3 hrs. 50 mg/l b. 3 hrs. 10 mg/l c. 6 hrs. 25 mg/l d. 6 hrs. 50 mg/l

DISINFECTION USING CHLORINE

Performance Checklist		
Step	**Yes**	**No**
1. Did trainee identify all the equipment needed for the job? • Sodium Hypochlorite • Calcium Hypochlorite • Tablets		
2. Did the trainee take proper safety precautions? • Use proper safety equipment • Ensured ventilation was available		
3. Did the trainee know how to properly disinfect a repaired main using the methods listed in the QTP? • Pre-Flushing • Disinfection. • Post-Flushing. • Testing.		
4. Does the trainee know how to calculate volume of rectangular and circular tanks?		
5. Does the trainee understand how to disinfect storage tanks?		
6. Did the trainee complete all the questions in the QTP? • Score 80% or higher. • Did the trainer review and explain all missed questions.		

FEEDBACK: Trainer should provide both positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer.



LOCATE VALVES

MODULE 12 **AFQTP UNIT 9**

UTILITY MAPS (12.9.1.)

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

UTILITY MAPS

Task Training Guide

STS Reference Number/Title:	12.9.1., Utility Maps
Training References:	• CDC 3E451A
Prerequisites:	• Possess as a minimum a 3E431 AFSC.
Equipment/Tools Required:	• Base Utility Map • Option: Probing Rod
Learning Objective:	• Trainee will locate valves using utility maps
Samples of Behavior:	• Trainee will understand the steps to locate valves using utility maps
Notes:	

UTILITY MAPS

Background: The plumbing language is not only spoken and written but also indicated on prints and drawings by the use of symbols. Most of these maps show the location of valves, fire hydrants, manholes, water lines, sewer lines, and gas lines to and from buildings. They also indicate the size and type of pipe . Anytime you make a change in a utility system (such as adding a new cutoff valve to a water line, installing an isolation valve, etc.), note the change on the utility maps. This also applies to the prints for buildings. To easily locate valves on utility maps, it is a must to keep your utility maps updated.

You must become familiar with symbols to interpret prints, drawings, and plans. If you come across a symbol that you cannot identify, check the legend on the drawing. The legend will also give you the scale of the drawing. When a pipe drawing contains more than one system, a legend is included on the drawing to identify the different lines and symbols shown on the layout. In most cases however the distribution and collection systems are broken down into three areas: Water Maps, Wastewater Maps, and Gas Maps.

NOTE:
This is only a general guide to locating valves using base utility maps. Check operating instructions at your installation for specific procedures.

To perform this task, follow these steps for locating valves using Utility maps:

Step 1: Gather Base Utility Maps. (See Figure 1).

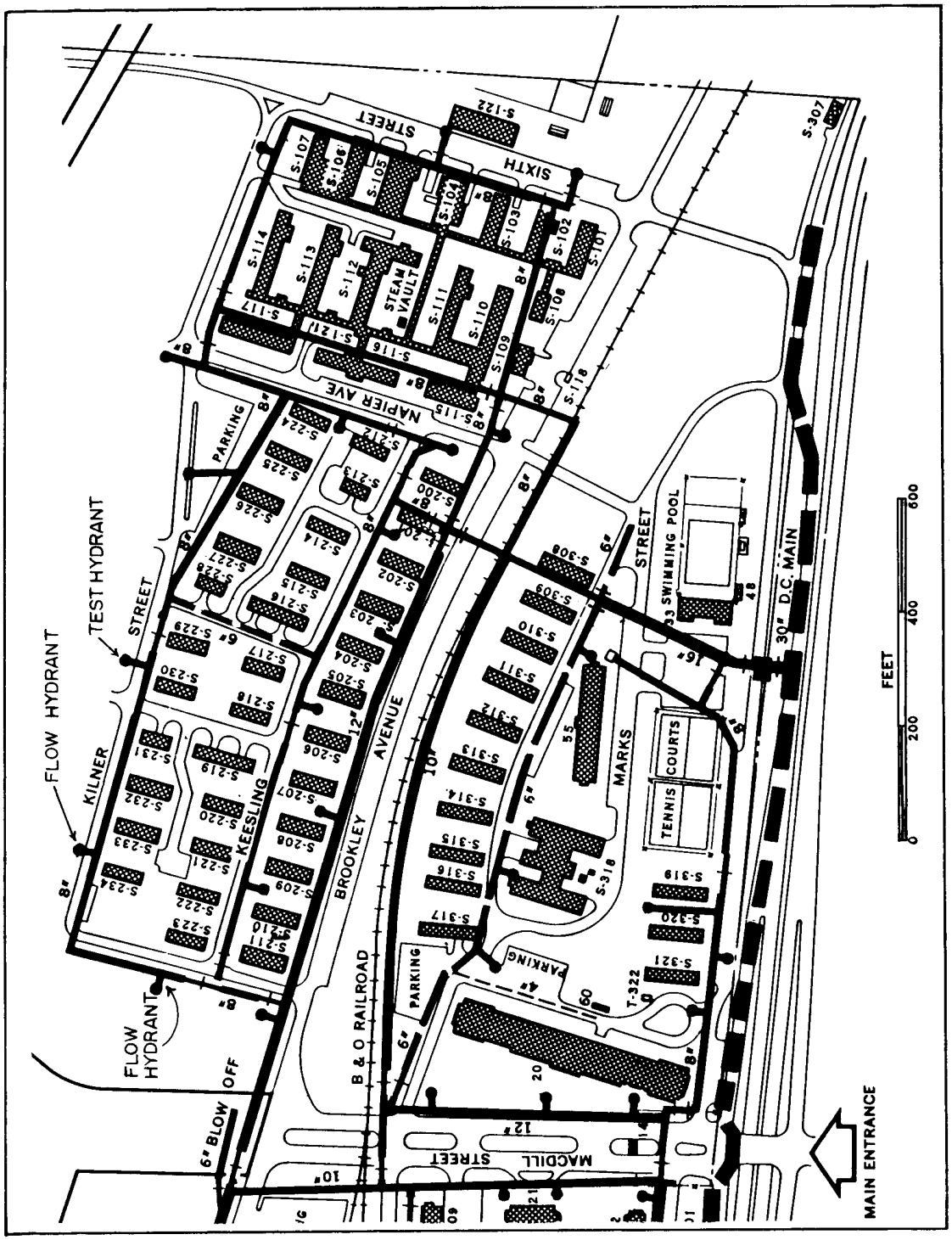


Figure 1, Base Utility Map

Step 2: Identify the valve number or valve location (intersecting streets or building numbers may assist you).

HINT:
Intersecting streets, familiar building numbers and general familiar areas can be used to help pinpoint a valve location on a base utility map.

Step 3: Locate the general area on the utility map.

Step 4: Pin point the valve location.

Step 5: Physically go to the location and verify the valve location.
A probing rod or a metal detector may be needed.

NOTE:
It is very well known that a valve located on a map could be difficult to physically locate. Valves can be easily paved over, covered with a shrubbery bed or covered with grass.

Review Questions
for
Utility Maps

Question	Answer
1. What must you do if adding a new isolation valve?	a. Inform all interested parties of the change b. Make a mental note of the location c. Inform Production Control of the change d. Note the new change on the utility maps
2. What tool should you use to help physically locate a valve?	a. A pipe b. A probing rod c. A stake d. A valve key
3. You do not have to keep utility maps updated to find valves easily.	a. True b. False
4. Symbols that you cannot identify can be found on the _____.	a. Legend b. Item itself c. Street d. Legacy

UTILITY MAPS

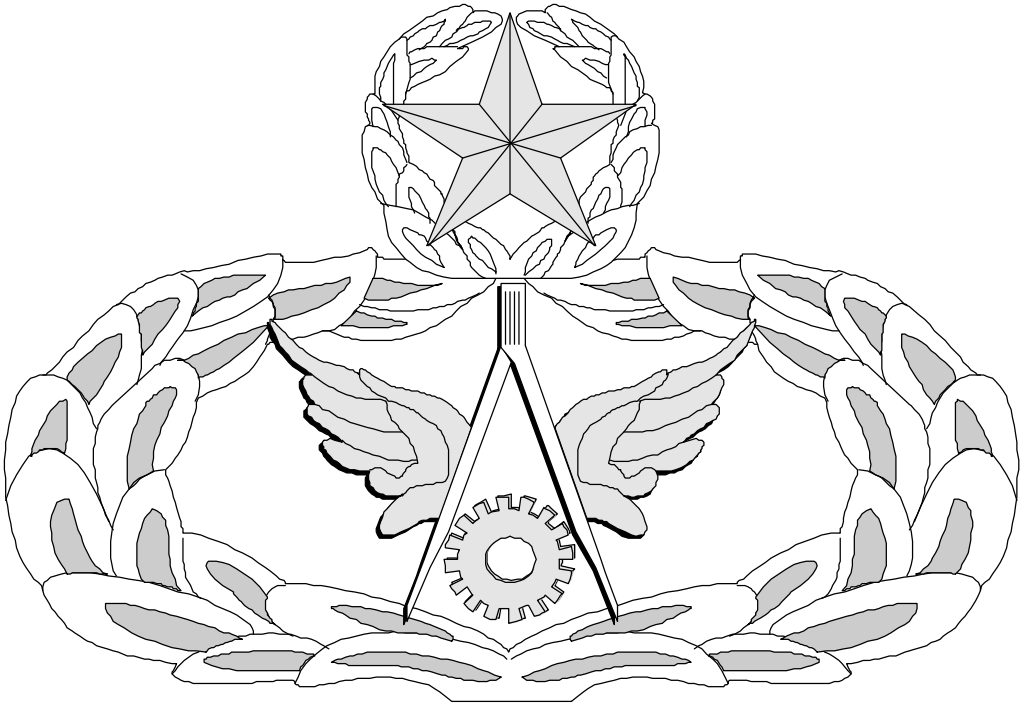
Performance Checklist		
Step	**Yes**	**No**
1. Did trainee identify all the equipment needed for the job? • Used Utility maps • Located probing rod		
2. Did the trainee properly locate valves using the utility map? • Gather Base Utility Maps • Identify the valve number or valve location • Locate the general area on the utility map • Pin point the valve location • Physically go to the location and verify the valve location		
3. Did the trainee understand the procedures to locate valves using utility maps?		
4. Did the trainee complete all the questions in the QTP? • Score 80% or higher. • Did the trainer review and explain all missed questions.		

FEEDBACK: Trainer should provide both positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer.

Air Force Civil Engineer

QUALIFICATION TRAINING PACKAGE (QTP)

REVIEW ANSWER KEY



For

UTILITIES SYSTEMS

(3E4X1)

MODULE 12

UTILITIES FUNDAMENTALS

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

CUT/REAM/TRHEAD/SWEAT PIPE

(3E4X1-12.6.)

Question	Answer
1. There are how many major steps to sweating pipe?	d. Four
2. What governs the bonding process in sweating?	c. Capillary Action
3. 95/5% Solder melts at ____degrees F.	d. 425
4. The amount of solder required for a connection depends upon the diameter of the tube to be sweated.	a. True
5. What causes the flux to burn out, oxidation, and the flux spreading unevenly?	a. Overheating the joint
6. Before soldering in a questionable are, you should have the Fire Department inspect the area and issue an AF Form 591, WELDING, CUTTING AND BRAZING PERMIT.	b. False
7. When a bead of solder appears at the edge of the fitting, what does this indicate?	a. The joint has all the solder it will take
8. What is used to remove excess solder?	a. A small brush or emery cloth
9. What is used to restore the inside diameter of the pipe by removing any burrs?	d. All of the above
10. What equipment should be inspected to ensure that they are sharp and free from excessive wear prior to threading pipe?	c. Die segments
11. What is used to keep the dies cool when threading pipe?	d. Cutting oil
12. How often should you apply cutting oil to the dies when using the manual pipe threader?	b. 2 to 3 strokes
13. When using a power threader you should lift the die release lever when ___ newly cut threads extend beyond the die segments.	c. 2
14. What should be used to clean the die segments?	d. Wire brush

DISINFECTION USING CHLORINE

(3E4X1-12.8.)

Question	Answer
1. What is the purpose of disinfection?	a. Kill organisms that are harmful
2. Which disinfectant has a chlorine content of 65% to 70%?	d. Calcium hypochlorite
3. What is the first step in disinfecting new mains?	a. Flushing the line
4. What is the minimum velocity when flushing mains?	b. 2.5 ft per sec
5. Which method is considered the least satisfactory?	c. Tablet
6. What is the minimum contact time and minimum chlorine residual for the slug method?	c. 3 hr. 100 mg/l
7. How many tablets of calcium hypochlorite will it take to have 50 mg/l dose for a 4 inch diameter pipe 30 ft long?	a. 1
8. Who do you notify when disposing of water that has a chlorine residual of more than 1 mg/l chlorine residual?	d. Wastewater plant operator
9. Who do you coordinate with to test the water after disinfection?	d. Bio-environmental engineering
10. Disinfect all portions of pipe, fittings, and materials used in repairs, with?	b. 5% hypochlorite solution
11. What is the minimum contact time and chlorine residual when disinfecting storage tanks?	d. 6 hr. 50 mg/l

UTILITY MAPS

(3E4X1-12.9.1.)

Question	Answer
1. What must you do if adding a new cutoff valve?	d. Note the new change on the utility maps
2. What tool should you use to help physically locate a valve?	b. A probing rod
3. You do not have to keep utility maps updated to find valves easily.	b. False
4. Symbols that you cannot identify can be found on the _____.	a. Legend